Stillwater Sciences

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Dan Ray
CALFED Bay-Delta Program
1416 Ninth Street, Suite 630
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May 10, 2002

Dear Mr. Ray,

These comments are offered by Stillwater Sciences, in collaboration with Bill Dietrich's geomorphology research group in the Department of Earth and Planetary Science at U.C. Berkeley, in response to the reviews of proposal #159: Physical modeling experiments to guide river restoration projects. We are gratified by the enthusiastic reviews of the two external scientific reviewers, and the appreciation expressed by the Technical Panel of the importance of the proposed work for advancing CALFED's ecosystem restoration priorities. Here we seek to clarify some outstanding questions, raised primarily by the regional reviews, which generally fall into three categories, budget items, linkages to specific CALFED supported restoration projects, and issues regarding transferring the insights gained in the experiments to the field application by practitioners and managers in ongoing and future CALFED funded restoration projects.

We are looking forward to your direction for revising the proposal for consideration as a directed action in the annual workplan. If you have any questions, please contact me at (510) 848-8098.

Sincerely,

Frank Ligon
Lead Scientist
Stillwater Sciences

Budget Issues

Schedule

We have darkened the shaded cells in Figure 1 (the schedule) so that it can be clearly read. The shaded cells indicate when the task is active, and the task (and any deliverables) will be completed during the last shaded month unless otherwise noted.

General Budget Issues

We have also included a new budget table that consolidates project management from the individual tasks into a single project management task (Task 6). The budget has not changed with this consolidation. We have also corrected the discrepancies between the annual budget and the total budget.

A laser scanner is not currently available through the University of California.

All contractor fees are included in the Services column and not Indirect Costs.

Cost Sharing

The University of California will share costs with CALFED on this project by funding graduate students who will be working on the project and by providing facilities for the meetings and experiments. We have included funding for two UC Berkeley graduate students for three years in our proposed budget. UC-Berkeley will fund two additional graduate students for three years to work on this project for a total cost of $288,360. The University will also provide the facilities where the experiments will take place. The use of these facilities including rent, utilities, security, and janitorial services will cost a total of $216,000 for the three years of the study. Finally, UC Berkeley will provide facilities for 30 meetings (at a cost of $500 per meeting) with a total cost of $15,000. UC Berkeley is contributing a total of $519,360 to this project.

Linkages to CALFED supported projects

Some review comments suggested that the proposed physical and numerical modeling be linked to ongoing and proposed CALFED restoration efforts. We provide here a description of how flume trials and numerical modeling will link with and contribute to CALFED-funded activities.

Channel-Floodplain Reconstruction

Physical modeling can be used to help guide the design of large-scale channel-floodplain reconfigurations. CALFED has provided funding for several large-scale channel-floodplain projects in the past few years, including:

- Lower Clear Creek Floodway Restoration Project, Phase 2 (ERP-98-F15)
- Tuolumne River Setback Levees and Channel Restoration (ERP-98-F06)
- Tuolumne River Mining Reach Restoration (ERP-97-M09)
- Tuolumne River Channel Restoration, Special Run Pool 9(ERP-97-M08)
- Merced River Salmon Habitat Enhancement, Ratzlaff Reach (ERP-99-B05)
- Merced River Salmon Habitat Enhancement, Robinson Ranch Site (ERP-01-N06)

CALFED has also received proposals in the last couple of years for additional large-scale channel and floodplain modification projects, including:

- Lower Clear Creek Floodway Restoration Project Phase 3 & 4 (2001-C201)
- Tuolumne River Mining Reach Restoration Project No. 3: Warner-Deardorff Segment (2001-C209)
- Tuolumne River Restoration: Special Run Pool 10 (2001-B201)
- Merced River Phase IV: Dredger Tailings Reach (2002-158) (recommended for directed funding)

An important goal of these projects is to re-scale the channel and re-grade the floodplain to be in balance with the regulated flow regime, which is typically reduced from historical conditions. CALFED acknowledges the uncertainty inherent in "scaling down" a river to be in balance with a regulated flow regime, as described in the ERP 2001 Proposal Solicitation Package (PSP):

> While we may be able to restore ecosystem function by restoring riverine processes at a reduced scale, we cannot scale down a river indefinitely, as there are basic thresholds below which a river will cease to function. . . We generally do not know the scale and balance of inputs—flow, sediment, organic material—and channel modifications that will restore ecosystem function. . . Restoring geomorphic processes so as to optimize ecosystem benefits will be a matter of both analysis and experimentation (CALFED 2001).

Physical modeling (flume experiments) can be used in conjunction with numerical models to help guide the design of channel and floodplain reconstruction projects. Developing a design for a re-scaled channel and floodplain involves a complex balancing of channel and floodplain geometry, the size of gravel that constitute the channel bed, and flow. Any change in one of these variables will affect the dimensions of the other two variables that will be required for restoring geomorphic processes. Re-scaling a channel and re-grading a floodplain is relatively costly (usually tens of millions of dollars) because of the physical manipulation of large volumes of material, as well as the careful planning and development of engineering designs involved. If a re-designed channel and floodplain do not perform as expected, it is also relatively expensive to try and fix the project, because of the physical manipulation of large volumes of material involved.

The flume trials that we are proposing to conduct will be used to refine and calibrate numerical models that will be generally useful in assisting the design of future CALFED or CALFED-funded projects that involve re-scaling a channel or re-grading a floodplain in balance with a regulated flow regime. The numerical models will allow managers to conduct gaming exercises by exploring a wide range of combinations of channel-floodplain geometry, sediment particle size distributions, and flow. Stillwater Sciences has a proposal for a channel-floodplain reconfiguration project on the Merced River (Merced River Phase IV) that has been recommended for consideration for directed funding. It is our intention to use the Merced Phase IV project as a case study for physical and numerical modeling if both projects receive funding as directed actions. We can also use some other currently or future CALFED-funded channel-floodplain reconstruction project to serve as a case study for conducting flume trials and applying numerical models.

Gravel Augmentation

CALFED has identified gravel augmentation as a restoration strategy for most Bay-Delta tributaries regulated by dams. The proposed wide application of this strategy acknowledges the fundamental disconnect that dams represent for rivers by trapping sediment, thereby depriving downstream reaches of a fundamental building block of habitat. CALFED has already provided funding for gravel augmentation projects, including:

- Tuolumne River: Gravel at Basso Bridge (ERP-97-C11)
- Stanislaus River: Knights Ferry Gravel Replenishment (ERP-97-M21)

In addition to these projects, gravel augmentation is a strategy that is used in conjunction with the channel-floodplain reconstruction projects that CALFED has funded on Clear Creek, the Tuolumne River, and the Merced River, as described above

The only current guidelines widely available to assist in selecting the size distribution of gravel to be injected into a channel have been developed by CDFG. The CDFG guidelines generally define the range of gravel sizes that are appropriate for salmonid spawning needs; thus, the guidelines have a biological basis. Restoration managers have very little guidance in selecting appropriate gravel sizes based upon geomorphic characteristics. The injection of spawning sized gravel into a channel may not provide a long-term habitat benefit if the size distribution and volume of the added gravels do not balance with the geomorphic characteristics of the channel. Gravel that is too small (relative to the transport capacity of a stream reach) may be mobilized too frequently and transported too far downstream to provide lasting habitat benefits, necessitating additional gravel supplementation to maintain habitat. Conversely, added gravel that is too large may not mobilize frequently enough, allowing fine sediments to fill the interstitial space, thereby reducing the quality of the gravel and the habitat.

The scale and breadth of CALFED's proposed gravel augmentation in Bay-Delta tributaries will significantly increase the demand for gravel. Increased demand will likely increase the cost of gravel, thereby increasing restoration costs. CALFED has already experienced this phenomena in the Tuolumne River, where the cost of implementing channel-floodplain reconstruction projects in the Mining Reach and SRP 10 have increased as the per unit cost of gravel has risen, stimulated in large measure by the increased demand for gravel that CALFED creates through restoration. It will be important for CALFED to protect its investment in gravel augmentation by ensuring that the added gravel will provide lasting habitat benefits.

The proposed physical modeling will allow Stillwater Sciences and UC Berkeley to refine and calibrate numerical models such as the Enhanced Acronym Series Interface (EASI) model to make them more generally applicable to Bay-Delta tributaries. Improving the capabilities of such numerical models will provide a quick, low-cost tool that can be used to help design future gravel augmentation projects. Such tools will assist restoration managers in selecting the appropriate size distribution for added gravel based upon the unique geomorphic characteristics of a proposed injection site. In this manner, the added gravel will be more likely to be mobilized and transported in a manner to optimize the habitat they provide. The model will also be useful in identifying the flow events we expect to transport gravel, which will help define the triggers for when monitoring and additional augmentation are required. The physical and numerical modeling will also assist decision making regarding the amount of gravel that needs to be injected in a stream, as well as the frequency of sediment augmentation. Following refinement and calibration, the numerical models will be available for application in any Bay-Delta tributary location where gravel injection is proposed. In addition to assisting the selection of an appropriate size distribution for added gravels, the EASI model will also be available to help restoration managers evaluate different potential injection sites.

The proposed modeling will likely be most applicable in Clear Creek, Tuolumne River, Stanislaus River, and Merced River, where gravel augmentation activities are likely to occur in the near future.

Dam Removal

CALFED funded UC Davis and Stillwater Sciences to conduct a combination of physical and numerical modeling as part of the decommissioning of Saeltzer Dam on Clear Creek. Stillwater Sciences applied a numerical model to predict the transport of sediment accumulated behind the dam. Regulatory agencies often require extensive mining of sediment accumulated in reservoirs prior to dam removal. Such requirements are grounded in a fear that flows will erode the accumulated sediments in the reservoir and transport them downstream in a pulse, inundating valuable downstream spawning riffles, possibly entombing incubating salmonid eggs. Also, excavation of reservoir sediments is often conducted because of a fear that sediment will pulse downstream and exacerbate local flooding by aggrading downstream channel reaches. Removal of sediment accumulated in a reservoir can be expensive, and it can deprive downstream habitats of a valuable source of material. For example, approximately 20,000 yds^3 of sediment were excavated from the Saeltzer Dam reservoir area, exposing significant areas of bedrock. Much of the excavated material was gravel that could have served as a valuable source of material if left in the channel.

UC Davis conducted flume experiments to complement the numerical modeling conducted by Stillwater Sciences. UC Davis had to send a graduate student to the University of Minnesota for a summer to conduct the flume experiments, since the Univ. of Minnesota had the facilities and equipment available to conduct the flume trials on short notice. The combined numerical and physical modeling conducted as part of the Saeltzer Dam decommissioning contributed to our scientific understanding of how sediment accumulated behind a dam will be transported as dams are removed.

Our proposal will upgrade UC Berkeley's flume facilities to allow such flume trials as those conducted for the Saeltzer Dam decommissioning to be conducted closer to home. Local flume facilities will improve opportunities for involvement by local scientists. The close proximity of the flume facilities will also enhance opportunities for presentations to stakeholders. The proposed flume and numerical modeling will greatly benefit CALFED in planning how to remove three dams as part of the Battle Creek restoration project. If funded, we intend to use the removal of the Battle Creek dams as a case study for conducting flume trials and refining numerical model.

General knowledge transfer and implementation issues

Scaling up from laboratory model to field

Concern was expressed by the Delta regional review and the Selection Panel regarding scaling up the experimental results to field application. The quantitative relationships that allow extrapolation of small-scale laboratory (model) results to large-scale field settings (prototype) are very well established in the river hydraulics and fluvial geomorphological literature. These essential relationships take the form of non-dimensional ratios, as discussed in the proposal and summarized in Table 1. In addition to the four basic fluid mechanical and sedimentological scaling parameters, we propose to use two additional non-dimensional parameters that are based on the fundamental principle of conservation of sediment mass. The high confidence in the feasibility of this proposal expressed by the external scientific reviewers and the Technical Panel reflects an implicit recognition of the validity of this scaling approach.

The most difficult aspect of using laboratory models to simulate field conditions is not maintaining similarity of the physical processes from small to large scale, but rather involves the experimental design. Natural rivers are complex systems of interdependent variables that can only be represented in physical models by simplified systems, in which the key variables of interest (e.g. grain size distribution, discharge) are manipulated systematically and independently, while the effects of other variables (e.g. large woody debris, bank irregularities) are excluded We propose to focus on those key variables that can be manipulated in both the laboratory and field restoration settings. By varying these variables independently, and through a wide range of values, we expect to obtain new understanding that will have general applicability in a variety of field settings. Restoration sites where other variables matter strongly, such as where frequent wood jambs influence bed texture, will require integrating the insights derived from our wood-free laboratory channels with knowledge of the effects of flow obstructions derived from other studies.

Excellent texts discussing the use of non-dimensional scaling parameters in relating flume studies to field applications include Yalin (1971), Sharp (1981) and Baker et al. (1991). A representative sample of the many papers reporting successful use of scaling relations to apply flume results to rivers includes Williams (1970), Southard and Boguchwal (1978), Karcz and Kersey (1980), Kochel and Ritter (1987), Lisle et al. (1997), and Seal et al. (1998). Properly scaled flume experimentation to guide river restoration is a largely untapped scientific resource (an oversight we intend to at least begin to correct), however, two good examples are restoration projects on the Kissimmee River in Florida (Shen et al. 1994) and Trinity River in Northern California (Wilcock, 1998).

Numerical models

Some questions were raised by both the Delta regional review and the technical panel regarding the merit and user-friendliness of the numerical models to be developed in the course of the project. As far as merit is concerned, the flume experiments are expressly designed to provide a comprehensive empirical basis for, and systematic test of, the applicability of numerical models currently in use or planned for use in Calfed supported restoration projects, for each of the three restoration strategies. The EASI bedload sediment transport model and DREAM dam removal model are both based on the well-established and widely-used multiple grain-size transport model of Parker (1990). The gravel augmentation and dam removal experimental results will be used to test and refine the use of these models in the specific context of habitat restoration on tributaries and mainstems of the Sacramento and San Joaquin Rivers. Similarly, the experimental results from the channel and floodplain redesign experiments will be used to extend the leading model for predicting meander migration, that of Johannesson and Parker (1989), which Larsen (1995) has adapted for use on the Sacramento, to specifically address the effect of altered sediment supply and discharge regime on equilibrium channel width and lateral migration rate. The proposed flume experiments will provide the strong empirical foundation necessary for the reliable use of these models in designing and managing costly and ecologically important Calfed-supported restoration projects.

With regard to ease of use, each of the numerical models will be in the Microsoft Excel format, utilizing a user-friendly interface featuring button commands and a transparent decision tree. The user interface is built with the standard Excel visual basic macro script, which provides a shell insulating the user from the underlying code that implements the sediment transport and meander migration calculations. The user provides the input data in a familiar Excel spreadsheet environment and receives output in the form of Excel graphs and tables. The Excel-based format allows for nearly universal compatibility with the personal computers of restoration practitioners and managers. Accompanying each model will be a pdf-formatted manual describing the interface and use of the model; instructions for applying the model in the field context will be provided in the restoration guidelines manuals discussed in the dissemination of results section below.

Dissemination of results

Several reviewers requested additional information on how the new knowledge derived from the experimental results would be made available to restoration practitioners and managers. We plan five primary modes of dissemination of the results: 1) technical reports provided to Calfed and other agencies, and papers submitted to peer-reviewed technical journals, that provide detailed information regarding experimental design, methods, results (including all data) and scientific interpretation, and that would allow engineers, geomorphologists and others with the appropriate technical training to fully understand the research program and independently interpret the results; 2) a set of practical guidelines, one for each of the three restoration strategies (gravel augmentation, dam removal, and channel and floodplain redesign), in the form of manuals written for restoration practitioners and managers, that provide methodologies for evaluation of the restoration potential of a site, data collection needs and priorities, appropriate use of numerical models, optimization (in terms of both implementation cost and restoration benefit) of restoration opportunities regarding modifying channel morphology, sediment supply and flow regime, and adaptive management techniques for monitoring and refinement of project implementation; 3) annual workshops (three total), primarily intended for restoration practitioners and managers working on Calfed supported projects and held at the Richmond Field Station hydraulics laboratory, which will combine technical presentations covering the experimental design, methods and results to-date with open discussion by participants of their field experiences and implementation concerns; 4) an extensive web site providing a clearinghouse of information on each of the three restoration strategies, including detailed and frequently updated documentation of the ongoing experiments, as well as links to other relevant sites and downloadable documents, with the goal of creating the web's best resource on these restoration strategies; and 5) we will produce a video that documents and summarizes the experimental results and synthesizes the guidelines for restoration design, aimed at an audience of restoration practitioners and managers.

Peer review and outreach

The technical panel and the San Joaquin regional review both suggested that we expand the scope of peer review and provide for input from restoration practitioners. We agree that the project would benefit from multi-disciplinary review at intermediate stages, and will therefore establish a review panel composed of six to eight scientists and restoration practitioners and managers to provide input and oversight through quarterly meetings and periodic visits to the laboratory by review panel members and visits to appropriate field sites by the staff and students conducting the laboratory experiments. This additional review provided by the panel would augment the peer review built into the scientific publication process and the opportunity for interaction with restoration practitioners provided by the annual workshops.

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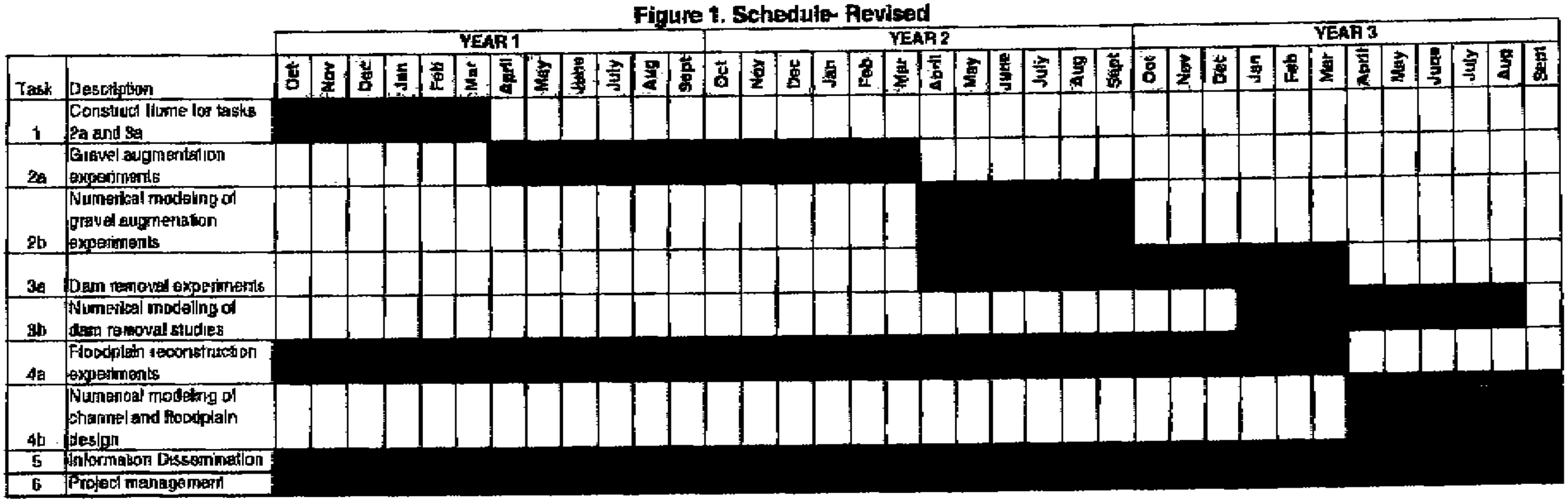
Figure 1. Schedule- Revised



The shaded areas indicate activity for the given task.

Figure 2: Form VI Summary

Year 1	Direct Labor Hours	Salary	Benefits	Travel	Supplies & Expendables	Services / Consultants	Equipment	Other Direct Costs	Total Direct Costs	Indirect Costs	Total Costs
Task 1 Flume construction for tasks 2 and 3	2880	$ 60,360	$ 20,384		$ 180,000	$ 5,000		5600	$ 271,343	$ 124,760	$ 396,103
Total cost Task 1 Year 1	2880	$ 60,360	$ 20,384	$ -	$ 180,000	$ 5,000	0	5600	$ 271,343	$ 124,760	$ 396,103
Task 2a. Gravel augmentation experiments	2880	$ 60,360	$ 20,384			$ 5,000			$ 85,743	$ 106,200	$ 191,943
Task 2b Numerical modeling of gravel augmetation experiments	0	$ -	$ -						$ -	$ -	$ -
Total cost Task 2 Year 1	2880	$ 60,360	$ 20,384	$ -	$ -	$ 5,000	0	0	$ 85,743	$ 106,200	$ 191,943
Task 3a Dam removal experiments	0	$ -	$ -						$ -	$ -	$ -
Task 3b. Numerical modeling of dam removal experiments	0	$ -	$ -						$ -	$ -	$ -
Total cost Task 3 Year 1	0	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Task 4a Channel/floodplain restoration flume experiments	3600	$ 81,807	$ 20,873		$ 150,000	$ 6,000		7700	$ 246,380	$ 124,605	$ 370,985
Task 4b Numerical modeling of Task 4a	0	$ -	$ -						$ -	$ -	$ -
Total cost Task 4 Year 1	3600	$ 81,807	$ 20,873	$ -	$ 150,000	$ 6,000	$ -	$ 7,700	$ 246,380	$ 124,605	$ 370,985
Task 5. Information dissemination	188	$ 5,429	$ 1,639			$ 593		366	$ 8,161	$ 9,597	$ 17,758
Total cost Task 5 Year 1	188	$ 5,429	$ 1,639	$ -	$ -	$ 593	0	366	$ 8,161	$ 9,597	$ 17,758
Task 6. Project management	1061	$ 20,884	$ 7,053						$ 27,937	$ 9,597	$ 37,534
Total Task 6 Year 1	1061	$ 20,884	$ 7,053						$ 27,937	$ 9,597	$ 37,534

Year 2	Direct Labor Hours	Salary	Benefits	Travel	Supplies & Expendables	Services / Consultants	Equipment	Other Direct Costs	Total Direct Costs	Indirect Costs	Total Costs
Task 1 Flume construction for tasks 2 and 3	0	$ -	$ -						$ -	$ -	$ -
Total cost Task 1 Year 2	0	$ -	$ -	$ -	$ -	$ -	0	0	$ -	$ -	$ -
Task 2a Gravel augmentation experiments	2880	$ 62,774	$ 21,199			$ 5,000		5600	$ 94,573	$ 110,988	$ 205,561
Task 2b Numerical modeling of gravel augmetation experiments	0	$ -	$ -						$ -	$ -	$ -
Total cost Task 2 Year 2	2880	$ 62,774	$ 21,199	$ -	$ -	$ 5,000	0	5600	$ 94,573	$ 110,988	$ 205,561
Task 3a Dam removal experiments	2880	$ 62,774	$ 21,199			$ 5,000		5600	$ 94,573	$ 110,988	$ 205,561
Task 3b Numerical modeling of dam removal experiments	0	$ -	$ -						$ -	$ -	$ -
Total cost Task 3 Year 2	2880	$ 62,774	$ 21,199	$ -	$ -	$ 5,000	$ -	$ 5,600	$ 94,573	$ 110,988	$ 205,561
Task 4a Channel/floodplain restoration flume experiments	3960	$ 64,280	$ 21,707			$ 24,119		7700	$ 117,807	$ 113,934	$ 231,741
Task 4b Numerical modeling of Task 4a	0	$ -	$ -						$ -	$ -	$ -
Total cost Task 4 Year 2	3960	$ 64,280	$ 21,707	$ -	$ -	$ 24,119	$ -	$ 7,700	$ 117,807	$ 113,934	$ 231,741

Task 5. Information dissemination	188	$ 5,429	$ 1,833			$ 533		366	$ 8,161	$ 9,597	$ 17,758
Total cost Task 5 Year 2	188	$ 5,429	$ 1,833	$ -	$ -	$ 533	0	366	$ 8,161	$ 9,597	$ 17,758
Task 6 Project management	1101	$ 21,695	$ 7,327						$ 29,022	$ 9,597	$ 38,619
Total Task 6 Year 1	1101	$ 21,695	$ 7,327						$ 29,022	$ 9,597	$ 38,619

Year 3	Direct Labor Hours	Salary	Benefits	Travel	Supplies & Expendables	Services / Consultants	Equipment	Other Direct Costs	Total Direct Costs	Indirect Costs	Total Costs
Task 1. Flume construction for tasks 2 and 3	0	$ -	$ -						$ -	$ -	$ -
Total cost Task 1 Year 3	0	$ -	$ -	$ -	$ -	$ -	0	0	$ -	$ -	$ -
Task 2a Gravel augmentation experiments	0	$ -	$ -						$ -	$ -	$ -
Task 2b. Numerical modeling of gravel augmentation experiments	216	$ 12,243	$ 4,134					420	$ 16,797	$ 21,481	$ 38,278
Total cost Task 2 Year 3	216	$ 12,243	$ 4,134	$ -	$ -	$ -	0	420	$ 16,797	$ 21,481	$ 38,278
Task 3a. Dam removal experiments	5958	$ 139,472	$ 47,100			$ 12,000		11585	$ 210,158	$ 246,598	$ 456,756
Task 3b. Numerical modeling of dam removal experiments	216	$ 12,243	$ 4,134					420	$ 16,797	$ 21,481	$ 38,278
Total cost Task 3 Year 3	6174	$ 151,715	$ 51,235	$ -	$ -	$ 12,000	$ -	$ 12,005	$ 226,955	$ 268,079	$ 495,034
Task 4a. Channel/floodplain restoration flume experiments	3630	$ 52,433	$ 17,707			$ 2,400		7058	$ 79,597	$ 92,764	$ 172,362
Task 4b Numerical modeling of Task 4a	216	$ 12,243	$ 4,134					420	$ 16,797	$ 21,481	$ 38,278
Total cost Task 4 Year 3	3846	$ 64,675	$ 21,841	$ -	$ -	$ 2,400	$ -	$ 7,478	$ 96,395	$ 114,245	$ 210,640
Task 5. Information dissemination	188	$ 5,429	$ 1,833			$ 533		366	$ 8,161	$ 9,597	$ 17,758
Total cost Task 5 Year 3	188	$ 5,429	$ 1,833	$ -	$ -	$ 533	0	366	$ 8,161	$ 9,597	$ 17,758
Task 6. Project management	1158	$ 26,007	$ 8,783						$ 34,790	$ 9,597	$ 44,387
Total Task 6 Year 1	1158	$ 26,007	$ 8,783						$ 34,790	$ 9,597	$ 44,387

Total Year 1	10609	208840	70526	0	330000	16533	0	13866	639564	374759	1014323
Total Year 2	11009	216952	73265	0	0	34652	0	19066	344196	355104	699240
Total Year 3	11582	260069	87826	0	0	14933	0	20269	383097	422999	806096
Total all years	33200	$ 685,860	$ 231,618	$ -	$ 330,000	$ 66,118	$ -	$ 53,201	$ 1,366,798	$ 1,152,862	$ 2,519,659
Total Task 1	2890	$ 60,380	$ 20,384	$ -	$ 180,000	$ 5,000	$ -	$ 5,600	$ 271,343	$ 124,760	$ 396,103
Total Task 2	5976	$ 135,377	$ 45,717	$ -	$ -	$ 10,000	$ -	$ 6,020	$ 197,114	$ 288,669	$ 485,783
Total Task 3	9054	$ 214,489	$ 72,434	$ -	$ -	$ 17,000	$ -	$ 17,605	$ 321,528	$ 379,067	$ 700,595
Total Task 4	11408	$ 190,762	$ 64,421	$ -	$ 150,000	$ 32,519	$ -	$ 22,878	$ 480,581	$ 352,784	$ 813,365
Total Task 5	564	$ 16,286	$ 5,500	$ -	$ -	$ 1,599	$ -	$ 1,098	$ 24,483	$ 28,791	$ 53,274
Total Task 6	3320	$ 68,586	$ 23,162	$ -	$ -	$ -	$ -	$ -	$ 91,748	$ 28,791	$ 120,539
Total all tasks	33200	685860	231618	0	330000	66118	0	53201	1366798	1152862	2519659
check	-	-	-	-	-	-	-	-	-	-	-